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The Development of certain Instincts and Habits in the Chicks. By FREDERICK S. BREED. Behavior Monographs, I., 1911. pp. 78.

This study—the first in the series of Behavior Monographs—records the results of experimental observations on chicks from the moment of their birth, covering a period of twenty-five days. The observations were made at the Harvard psychological laboratory, and pertain to the development of the drinking and pecking reactions, especially the latter. Incidentally the author studied the development of certain habits in response to visual stimuli, their interrelation, and the conditions which influence their persistence.

For these observations an incubator and a brooder were used, so arranged that a complete life history could be obtained of each bird. The widespread belief that chicks peck their way out of the shell is discredited by the author, who argues from the position of the chick in the shell that this could not be the case. Pecking is scarcely possible, since the chicken's head is folded down over the breast. A lifting movement of the head to free it and the neck from their folded position is probably responsible for the breaking of the shell, but the author brings no positive proofs that this is so. On the contrary, he states that chicks only a few hours out of the shell may be seen executing "into the air" what might be called the pecking reaction, followed by a sudden clapping together of the mandibles. This matter remains to be settled by the use of a technique recently developed elsewhere which permits the keeping of developing chicks *in situ*, under continuous observation.

Concerning their drinking reaction it is commonly held that chickens swallow water instinctively, but that they must learn to drink by imitation, if not by accident. This does not square with the author's observations, for he found that chicks respond with the drinking reaction to various olfactory impressions such as, surface of white paper, edge of white glazed kymograph paper, edge of glass dish, and black leather watch fob; they do so without any previous experience and under conditions which preclude the possibility of learning by imitation or by accident.

Whether the visual stimulus caused by still water is sufficient to bring about the drinking reaction, the author is not prepared to state definitely. According to the view now prevalent, such a stimulus is not enough. It would be interesting in this connection to know whether the sight of still water evokes the drinking reaction in chicks deprived of water for a long time after hatching. This matter, too, is left unsolved by the present investigator.

We turn now to the main portion of the author's work, his investigation of the pecking reaction; it consists of three distinct movements,—striking, seizing, and swallowing. The accuracy of this reaction, which has always occupied the center of attention among experimentalists, depends upon the degree of accuracy of each of these movements. In other words, the reaction as a whole may be retarded or it may fail at any one of these three stages. The widely quoted observations of Spalding, who blindfolded his chicks with hoods as soon as they left the shell, showed a great accuracy in pecking, the chicks never missing by more than a hair's breadth even the most minute particles at which they aim; what is more, they do not attempt to seize anything beyond their reach. These observations produced a profound impression and have been quoted abundantly, among others by Romanes, in order to illustrate the perfect adaptation of means to end through the operation of instinct. Preyer was among the earliest investigators to doubt this

view, although even he believed that the accuracy of the pecking reaction at the very beginning is marvelously perfect in chicks. By studying the reaction in its three component acts,—striking, seizing, swallowing,—the author found that Morgan and Thorndike, among the modern investigators, are correct when they assert that the pecking reaction is far from being perfect at birth. But he also found no reason to share Thorndike's doubt that this reaction improves after birth. Breed is convinced that it does; but whether the improvement is "dependent upon practice or is the natural functional correlate of structural maturation independent of practice" he is unable to state. In the absence of data which would justify either position to the total exclusion of the other, Breed is inclined to accept a view which represents the middle road. Improvement, while clearly influenced by practice, does not depend altogether upon it. Both maturation and use improve function. The improvement would proceed without practice but is hastened by it.

The author's most important finding about the pecking reaction, requiring however additional documentation before it may be accepted as fully established, is that the manifestation of the pecking instinct was retarded by disuse; also, that the retardation was quickly overcome by use. A corroboration of these data would justify, in a great measure, the author's position that both maturation and use enter as factors in improvement. The observations showed that, in the ordinary course, the accuracy of pecking improved most rapidly at first, reaching, by the third day, an efficiency represented by 29.29 upon a scale of fifty. At the beginning of the eleventh day the efficiency reached a little over 40. From that time on the rate of improvement was exceedingly slow so that, at the end of the period of observation, on the twenty-fifth day, it registered a maximum of 42.57.

The greatest number of errors in the pecking reaction were observed during the seizing act. This condition persisted throughout the period of observation. Swallowing led to fewer errors, but the striking act was the most accurate. From this it may readily be seen how one, limiting one's observations to the striking act or depending chiefly upon it for an appraisal of the pecking instinct, may be led to assume a degree of accuracy which does not hold for the reaction as a whole. Doubtless certain of the results of the earlier investigators have been influenced by some such limitation as this; hence the discrepancy between them and the results of the present study.

The author believes that he has discerned in chicks some selective response to objects of different size, also to color, apart of intensity; but form tests were uniformly negative. His findings as to the effect of social influence are not definite enough.

There was no evidence to show conclusively that an established black-blue habit influenced in any degree the rate of acquiring the small-large habit. The chicks were trained in the black-blue habit by the use of the electric shock, in the usual manner. It was found that frequently the reactions were determined not by the free color, but by the one with which the electric shock was associated. Such actively negative reactions show that, psychologically, negation is not affirmation.

Five of the nine chicks thus trained showed perfect tests in black-blue after a thirty days' interval. The "index of modifiability" for the whole group of nine was 72.2. Nothing was learned about the time of appearance of the various reactions, such as flapping the wings, preening, chirping, scratching, twittering, or wiping the bill.

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